

IN THE CLAIMS

1. (Currently Amended) A method for preparing a cycloolefin polymer containing polar functional groups, comprising:

preparing a catalyst mixture including

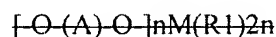
i) a precatalyst containing palladium and at least one ligand bonded to the palladium which is selected from the group consisting of acetylacetonate and acetate~~represented by Chemical Formula 1, containing a Group 10 transition metal having a ligand containing oxygen ions bonded to the metal;~~

ii) a first cocatalyst ~~which is an organic compound~~ represented by Chemical Formula 2 or Chemical Formula 3 which has an unshared electron pair and serves as an electron donor~~containing a Group 15 element; and~~

iii) a second cocatalyst represented by Chemical Formula 4 which is capable of providing an anion and weakly coordinating to the palladium ~~metal~~ of the precatalyst; and

subjecting a monomer solution comprising a norbornene-based compound containing a polar functional group as represented by Chemical Formula 5 to an addition polymerization reaction in the presence of an organic solvent and the catalyst mixture, at a temperature of 80-200 °C, the total amount of the organic solvent being 50-800 % by weight based on the total weight of the monomer contained in the monomer solution, and the product yield of the polymer being 50% by weight or more based on the total weight of the monomer:

~~Chemical Formula 1~~



~~wherein—~~

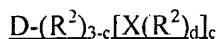
~~M is a Group 10 transition metal;—~~

~~n is 1 or 2;—~~

~~A represents a linear or branched C1-20 alkyl, aryl, aralkyl, alkenyl group or a linear or branched C1-20 alkyl, aryl, aralkyl or alkenyl group containing a hetero atom including Si, Ge, S, O, or N;—~~

~~R1 is hydrogen; a linear or branched C1-20 alkyl, alkenyl or vinyl group; a C3-12 cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C6-40 aryl group unsubstituted or substituted with a hydrocarbon; a C6-40 aryl group containing at least one hetero atom; a C7-15 aralkyl group unsubstituted or substituted with a hydrocarbon; or a C3-20 alkynyl group;~~

Chemical Formula 2



wherein

D is phosphorous a Group 15 element,

c is an integer of 0 to 3,

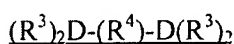
X is an oxygen, sulfur, nitrogen or silicon,

d is 1 when X is an oxygen or sulfur, 2 when X is a nitrogen atom, or 3 when X is a silicon,

R² is hydrogen; a linear or branched C₁₋₂₀ alkyl, alkoxy, allyl, alkenyl or vinyl group; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C₆₋₄₀ aryl group unsubstituted or substituted with a hydrocarbon; a C₇₋₁₅ aralkyl group unsubstituted or substituted with a hydrocarbon; a C₃₋₂₀ alkynyl group; a tri(linear or branched C₁₋₁₀ alkyl) silyl or tri(linear or branched C₁₋₁₀ alkoxy) silyl group; a tri(C₃₋₁₂ cycloalkyl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C₆₋₄₀ aryl unsubstituted or substituted with

a hydrocarbon) silyl group; a tri(C₆₋₄₀ aryloxy unsubstituted or substituted with a hydrocarbon) silyl group; a tri(linear or branched C₁₋₁₀ alkyl) siloxy group; a tri(C₃₋₁₂ cycloalkyl unsubstituted or substituted with a hydrocarbon) siloxy group; or tri(C₆₋₄₀ aryl unsubstituted or substituted with a hydrocarbon) siloxy group, in which all these substituents may be substituted with a linear or branched haloalkyl group or a halogen;

Chemical Formula 3



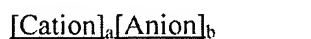
wherein

D is phosphorous-a Group 15 element,

R³ is as defined in R² of Chemical Formula 2,

R⁴ is a linear or branched C₁₋₅ alkyl, alkenyl or vinyl group; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C₆₋₂₀ aryl group unsubstituted or substituted with a hydrocarbon; or a C₇₋₁₅ aralkyl group unsubstituted or substituted with a hydrocarbon;

Chemical Formula 4



wherein

cation is selected from the group consisting of proton; cations of Group 1 and 2 metals; and organic groups containing these cations selected from the group consisting of ammoniums selected from the group consisting of [NH(R⁵)₃]⁺, [NH₂(R⁵)₂]⁺, [NH₃(R⁵)₁]⁺, and [N(R⁵)₄]⁺, phosphoniums selected from the group consisting of [PH(R⁵)₃]⁺, [PH₂(R⁵)₂]⁺, [PH₃(R⁵)₁]⁺, and [P(R⁵)₄]⁺, carboniums [C(R⁵)₃]⁺, [H(OEt₂)₂]⁺, [Ag]⁺, and [Cp₂Fe]⁺, in which R⁵ is a linear or branched C₁₋₂₀ alkyl group; an alkyl or silylalkyl group substituted with a halogen; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a hydrocarbon; a

cycloalkyl or silyl cycloalkyl group substituted with a halogen; a C₆₋₄₀ aryl group unsubstituted or substituted with a hydrocarbon; an aryl or silyl aryl group substituted with a halogen; a C₇₋₁₅ aralkyl group unsubstituted or substituted with a hydrocarbon; or an aralkyl or silyl aralkyl group substituted with a halogen, wherein anion is an anion capable of weakly coordinating to the palladium the metal M of the precatalyst, and is selected from the group consisting of a borate represented by Chemical Formula 4a or 4b, aluminate, [SbF₆], [PF₆], [AsF₆], perfluoroacetate ([CF₃CO₂]), perfluoropropionate ([C₂F₅CO₂]), perfluorobutyrate ([CF₃CF₂CF₂CO₂]), perchlorate ([ClO₄]), p-toluenesulfonate ([p-CH₃C₆H₄SO₃]), [SO₃CF₃], boratabenzene, and carborane unsubstituted or substituted with a halogen atom;

Chemical Formula 4a



Chemical Formula 4b



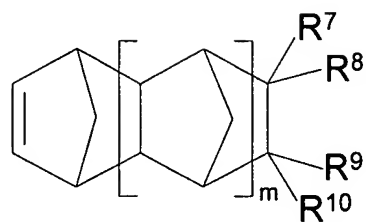
wherein

M' is a boron;

R⁶ is a halogen; a linear or branched C₁₋₂₀ alkyl or alkenyl group unsubstituted or substituted with a halogen atom; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a halogen; a C₆₋₄₀ aryl group which unsubstituted or substituted with a hydrocarbon; a C₆₋₄₀ aryl group substituted with a linear or branched C₃₋₂₀ trialkylsiloxy group or a linear or branched C₁₈₋₄₈ triarylsiloxy group; or a C₇₋₁₅ aralkyl group unsubstituted or substituted with a halogen, and

a and b are the number of the cations and anions, respectively, and determined to allow the cation and anion to be electrically neutralized and balance the charges;

Chemical Formula 5



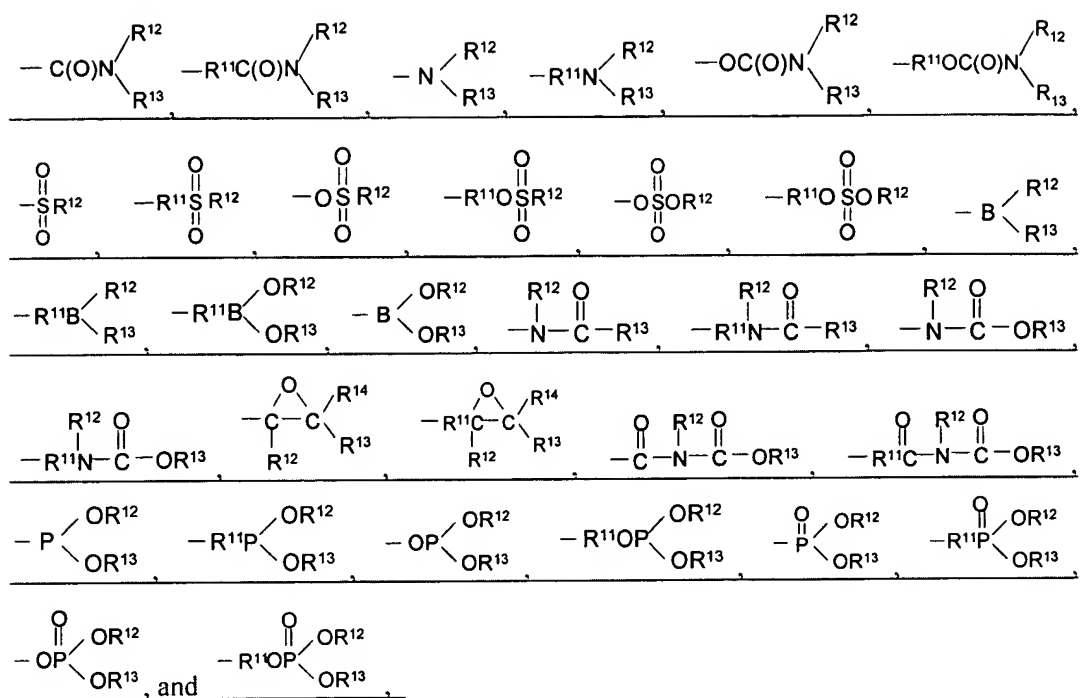
wherein

m is an integer of 0 to 4,

at least one of R⁷, R⁸, R⁹ and R¹⁰ is a polar functional group, the others are non-polar functional group, and R⁷, R⁸, R⁹ and R¹⁰ can be bonded together to form a saturated or unsaturated C₁₋₂₀ cyclic group or C₆₋₂₄ aromatic ring,

the non-polar functional group includes hydrogen; halogen; a linear or branched C₁₋₂₀ alkyl group; a linear or branched C₁₋₂₀ haloalkyl group; a linear or branched C₁₋₂₀ alkenyl group; a linear or branched C₁₋₂₀ haloalkenyl group; a linear or branched C₃₋₂₀ alkynyl group; a linear or branched C₃₋₂₀ haloalkynyl; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₆₋₄₀ aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C₇₋₁₅ aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl,

the polar functional group is a non-hydrocarbonaceous polar group containing at least one of O, N, P, S, Si and B, and is selected from the group consisting of: OR¹², OC(O)OR¹², R¹¹OC(O)OR¹², C(O)R¹², R¹¹C(O)R¹², OC(O)R¹², R¹¹OC(O)R¹², (R¹¹O)pOR¹², (OR¹¹)pOR¹², C(O)OC(O)R¹², R¹¹C(O)OC(O)R¹², SR¹², R¹¹SR¹², SSR¹², R¹¹SSR¹², S(=O)R¹², R¹¹S(=O)R¹², R¹¹C(=S)R¹², R¹¹C(=S)SR¹², R¹¹SO₃R¹², SO₃R¹², R¹¹N=C=S, NCO, R¹¹NCO, CN, R¹¹CN, NNC(=S)R¹², R¹¹NNC(=S)R¹², NO₂, R¹¹NO₂,



in which R^{11} is a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl, _

R^{12} , R^{13} , and R^{14} are each independently hydrogen; a halogen; a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a

C₆₋₄₀ aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₇₋₁₅ aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; or alkoxy, haloalkoxy, carbonyloxy, halocarbonyloxy, and

p is an integer of 1 to 10.

2. to 5. (Canceled)

6. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the organic solvent is selected from the group consisting of dichloromethane, dichloroethane, toluene, chlorobenzene and mixtures thereof.

7. (Canceled)

8. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the total amount of the organic solvent is 50-200 % by weight based on the total weight of the monomer contained in the monomer solution.

9. (Canceled)

10. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the polymerization reaction is performed at

a temperature of 80-150 °C.

11. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the catalyst mixture includes a metal catalyst complex containing a cation complex made of the precatalyst and the first cocatalyst and an anion complex made of the second cocatalyst.

12. (Currently Amended) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the catalyst mixture comprises, based on 1 mole of the precatalyst-containing ~~Group 10 transition metal~~, 1-3 moles of the first cocatalyst ~~containing the organic compound containing the Group 15 element~~; and 1-2 moles of the second cocatalyst ~~which is capable of providing an anion and weakly coordinating to the metal of the precatalyst~~.

13. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the molar ratio of the catalyst mixture based on the precatalyst ~~Group 10 transition metal compound~~ to the monomer contained in the monomer solution is in the range of 1:2,500 - 1:100,000.

14. (Currently amended) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the polar functional group of the ~~norbornene~~norbornene-based compound includes an ester group and an acetyl group.

15. (Canceled).

16. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the monomer solution further comprises a cycloolefin compound containing no polar functional group.

17. (Original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 16, wherein the molar ratio of the cycloolefin compound containing no polar functional group is 30 % by mole based on the total monomers contained in the monomer solution.

18. (Currently amended) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the cycloolefin polymer containing polar functional groups includes a homopolymer of a cycloolefin monomer containing a polar functional group, a copolymer of cycloolefin monomers containing different polar functional groups, and a copolymer of cycloolefin ~~monomers~~monomers containing a polar functional group and cycloolefin monomers containing no polar functional group.

19. (Original) The method for preparing a cycloolefin polymer containing polar

functional groups according to claim 1, wherein a molecular weight (Mw) of the cycloolefin polymer containing polar functional groups is in the range of 100,000-1,000,000.

20. (Original) An optical anisotropic film comprising a cycloolefin polymer containing polar functional groups which is prepared by a method as claimed in claim 1 and has a molecular weight of 100,000 or more.

21. (Original) The optical anisotropic film according to claim 20, wherein the optical anisotropic film has 70 to 1000 nm of a retardation value (Rth), as defined by the following equation 1:

(Equation 1)

$$R_{th} = \Delta(n_y - n_z) \times d$$

wherein, n_y is a refractive index in a fast axis direction in a plane, measured at a wavelength of 550 nm;

n_z is a refractive index in a thickness direction, measured at a wavelength of 550nm; and

d is the film thickness.

22. (Currently amended) The optical anisotropic film according to claim 20, the refractive index of the optical anisotropic film satisfies the following equation 3:

(Equation 3)

$$n_x \cong n_y > n_z \quad n_x \cong n_y > n_z$$

wherein, n_x is a refractive index in a slow axis direction in a plane, n_y is a refractive index in a fast axis direction in the plane, and n_z is a refractive index in a thickness direction.

23. (Original) The optical anisotropic film according to claim 22, wherein the optical anisotropic film is used as a negative C-plate type optical compensation film for Liquid Crystal Displays.

24. (Original) A display device comprising an optical anisotropic film as claimed in claim 20.

25. (Currently amended) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein i) the precatalyst is selected from the group consisting of an $\text{Pd}(\text{acetyl acetate})_2$, $\text{Pd}(\text{acetate})_2$, and $(\text{acetate})\text{Pd}(\text{acetyl acetate})$, $(\text{allyl})\text{Pd}(\text{acetyl acetate})$, and $(\text{allyl})\text{Pd}(\text{acetate})$.

26. (Previously Presented) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein ii) the first cocatalyst is tricyclohexylphosphine.

27. (Previously Presented) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein iii) the second cocatalyst is dimethyl aniliniumtetrakis(pentafluorophenyl)borate.

28. (Previously Presented) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the norbornene-based compound contains a polar functional group selected from the group consisting of 5-norbornene-2-carboxylic acid methyl ester, 5-norbornene-2-carboxylic acid butyl ester, 5-norbornene-2-allylacetate, 5-norbornene-2-acetate.

29. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the norbornene-based compound containing the polar functional group comprises more than 50 mol% of the exo-isomer.

30. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 29, wherein the polar functional group of the norbornene-based compound is an ester group or an acetyl group.

31. (New) A method for preparing a cycloolefin polymer containing polar functional groups, comprising:

preparing a catalyst mixture including

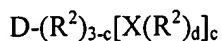
i) a precatalyst containing palladium and at least one ligand bonded to the palladium which is selected from the group consisting of a β -diketonate and a carboxylate;

ii) a first cocatalyst represented by Chemical Formula 2 or Chemical Formula 3 which has an unshared electron pair and serves as an electron donor; and

iii) a second cocatalyst represented by Chemical Formula 4 which is capable of providing an anion and weakly coordinating to the palladium of the precatalyst; and

subjecting a monomer solution comprising a norbornene-based compound containing a polar functional group and comprising more than 50 mol% of the exo-isomer as represented by Chemical Formula 5 to an addition polymerization reaction in the presence of an organic solvent and the catalyst mixture, at a temperature of 80-200 °C, the total amount of the organic solvent being 50-800 % by weight based on the total weight of the monomer contained in the monomer solution, and the product yield of the polymer being 50% by weight or more based on the total weight of the monomer:

Chemical Formula 2



wherein

D is phosphorous,

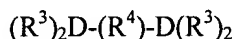
c is an integer of 0 to 3,

X is an oxygen, sulfur, nitrogen or silicon,

d is 1 when X is an oxygen or sulfur, 2 when X is a nitrogen atom, or 3 when X is a silicon,

R^2 is hydrogen; a linear or branched C_{1-20} alkyl, alkoxy, allyl, alkenyl or vinyl group; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; a C_{3-20} alkynyl group; a tri(linear or branched C_{1-10} alkyl) silyl or tri(linear or branched C_{1-10} alkoxy) silyl group; a tri(C_{3-12} cycloalkyl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C_{6-40} aryl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C_{6-40} aryloxy unsubstituted or substituted with a hydrocarbon) silyl group; a tri(linear or branched C_{1-10} alkyl) siloxy group; a tri(C_{3-12} cycloalkyl unsubstituted or substituted with a hydrocarbon) siloxy group; or tri(C_{6-40} aryl unsubstituted or substituted with a hydrocarbon) siloxy group, in which all these substituents may be substituted with a linear or branched haloalkyl group or a halogen;

Chemical Formula 3



wherein

D is phosphorous,

R^3 is as defined in R^2 of Chemical Formula 2,

R^4 is a linear or branched C_{1-5} alkyl, alkenyl or vinyl group; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C_{6-20} aryl group unsubstituted or substituted with a hydrocarbon; or a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon;

Chemical Formula 4

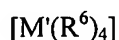


wherein

cation is selected from the group consisting of proton; cations of Group 1 and 2

metals; and organic groups containing these cations selected from the group consisting of ammoniums selected from the group consisting of $[\text{NH}(\text{R}^5)_3]^+$, $[\text{NH}_2(\text{R}^5)_2]^+$, $[\text{NH}_3(\text{R}^5)_1]^+$, and $[\text{N}(\text{R}^5)_4]^+$, phosphoniums selected from the group consisting of $[\text{PH}(\text{R}^5)_3]^+$, $[\text{PH}_2(\text{R}^5)_2]^+$, $[\text{PH}_3(\text{R}^5)_1]^+$, and $[\text{P}(\text{R}^5)_4]^+$, carboniums $[\text{C}(\text{R}^5)_3]^+$, $[\text{H}(\text{OEt}_2)_2]^+$, $[\text{Ag}]^+$, and $[\text{Cp}_2\text{Fe}]^+$, in which R^5 is a linear or branched C_{1-20} alkyl group; an alkyl or silylalkyl group substituted with a halogen; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a cycloalkyl or silyl cycloalkyl group substituted with a halogen; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; an aryl or silyl aryl group substituted with a halogen; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; or an aralkyl or silyl aralkyl group substituted with a halogen, wherein anion is an anion capable of weakly coordinating to the palladium of the precatalyst, and is a borate represented by Chemical Formula 4a or 4b;

Chemical Formula 4a



Chemical Formula 4b



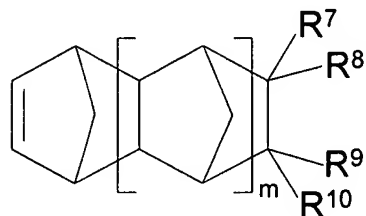
wherein

M' is a boron;

R^6 is a halogen; a linear or branched C_{1-20} alkyl or alkenyl group unsubstituted or substituted with a halogen atom; a C_{3-12} cycloalkyl group unsubstituted or substituted with a halogen; a C_{6-40} aryl group which unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group substituted with a linear or branched C_{3-20} trialkylsiloxy group or a linear or branched C_{18-48} triarylsiloxy group; or a C_{7-15} aralkyl group unsubstituted or substituted with a halogen, and

a and b are the number of the cations and anions, respectively, and determined to allow the cation and anion to be electrically neutralized and balance the charges;

Chemical Formula 5



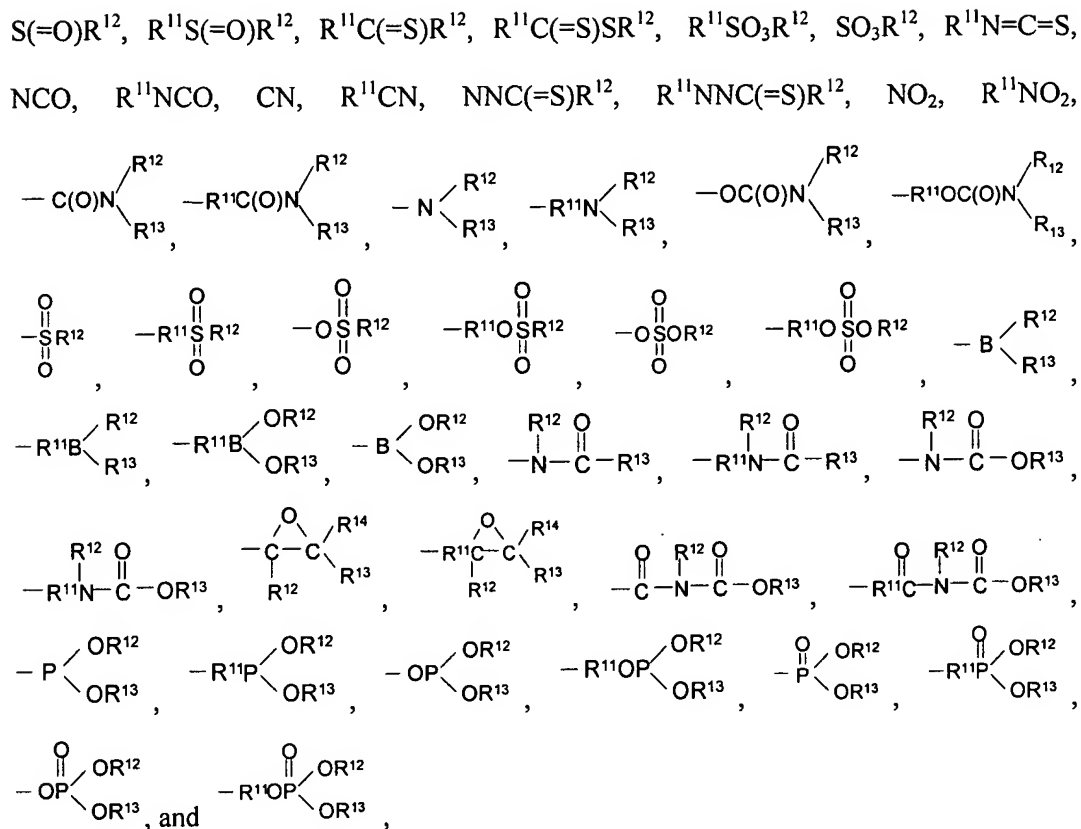
wherein

m is an integer of 0 to 4,

at least one of R^7 , R^8 , R^9 and R^{10} is a polar functional group, the others are non-polar functional group, and R^7 , R^8 , R^9 and R^{10} can be bonded together to form a saturated or unsaturated C_{1-20} cyclic group or C_{6-24} aromatic ring,

the non-polar functional group includes hydrogen; halogen; a linear or branched C_{1-20} alkyl group; a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl,

the polar functional group is a non-hydrocarbonaceous polar group containing at least one of O, N, P, S, Si and B, and is selected from the group consisting of: OR^{12} , $OC(O)OR^{12}$, $R^{11}OC(O)OR^{12}$, $C(O)R^{12}$, $R^{11}C(O)R^{12}$, $OC(O)R^{12}$, $R^{11}OC(O)R^{12}$, $(R^{11}O)_pOR^{12}$, $(OR^{11})_pOR^{12}$, $C(O)OC(O)R^{12}$, $R^{11}C(O)OC(O)R^{12}$, SR^{12} , $R^{11}SR^{12}$, SSR^{12} , $R^{11}SSR^{12}$,



in which R^{11} is a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl,

R^{12} , R^{13} , and R^{14} are each independently hydrogen; a halogen; a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20}

alkynyl group; a linear or branched C₃₋₂₀ haloalkynyl; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₆₋₄₀ aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₇₋₁₅ aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; or alkoxy, haloalkoxy, carbonyloxy, halocarbonyloxy, and

p is an integer of 1 to 10.

32. (New) A method for preparing a cycloolefin polymer containing polar functional groups, comprising:

preparing a catalyst mixture consisting of

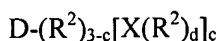
i) a precatalyst selected from the group consisting of an $\text{Pd}(\text{acetyl acetate})_2$, $\text{Pd}(\text{acetate})_2$, and $(\text{acetate})\text{Pd}(\text{acetyl acetate})$;

ii) a first cocatalyst represented by tricyclohexylphosphine; and

iii) a second cocatalyst represented by dimethylanilinium tetrakis(pentafluorophenyl)borate; and

subjecting a monomer solution comprising a norbornene-based compound containing a polar functional group and comprising more than 50 mol% of the exo-isomer as represented by Chemical Formula 5 to an addition polymerization reaction in the presence of an organic solvent and the catalyst mixture, at a temperature of 80-200 °C, the total amount of the organic solvent being 50-800 % by weight based on the total weight of the monomer contained in the monomer solution, and the product yield of the polymer being 50% by weight or more based on the total weight of the monomer:

Chemical Formula 2



wherein

D is phosphorous,

c is an integer of 0 to 3,

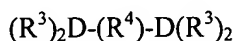
X is an oxygen, sulfur, nitrogen or silicon,

d is 1 when X is an oxygen or sulfur, 2 when X is a nitrogen atom, or 3 when X is a silicon,

R^2 is hydrogen; a linear or branched C_{1-20} alkyl, alkoxy, allyl, alkenyl or vinyl

group; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C₆₋₄₀ aryl group unsubstituted or substituted with a hydrocarbon; a C₇₋₁₅ aralkyl group unsubstituted or substituted with a hydrocarbon; a C₃₋₂₀ alkynyl group; a tri(linear or branched C₁₋₁₀ alkyl) silyl or tri(linear or branched C₁₋₁₀ alkoxy) silyl group; a tri(C₃₋₁₂ cycloalkyl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C₆₋₄₀ aryl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C₆₋₄₀ aryloxy unsubstituted or substituted with a hydrocarbon) silyl group; a tri(linear or branched C₁₋₁₀ alkyl) siloxy group; a tri(C₃₋₁₂ cycloalkyl unsubstituted or substituted with a hydrocarbon) siloxy group; or tri(C₆₋₄₀ aryl unsubstituted or substituted with a hydrocarbon) siloxy group, in which all these substituents may be substituted with a linear or branched haloalkyl group or a halogen;

Chemical Formula 3



wherein

D is phosphorous,

R³ is as defined in R² of Chemical Formula 2,

R⁴ is a linear or branched C₁₋₅ alkyl, alkenyl or vinyl group; a C₃₋₁₂ cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C₆₋₂₀ aryl group unsubstituted or substituted with a hydrocarbon; or a C₇₋₁₅ aralkyl group unsubstituted or substituted with a hydrocarbon;

Chemical Formula 4

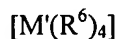


wherein

cation is selected from the group consisting of proton; cations of Group 1 and 2 metals; and organic groups containing these cations selected from the group consisting of

ammoniums selected from the group consisting of $[\text{NH}(\text{R}^5)_3]^+$, $[\text{NH}_2(\text{R}^5)_2]^+$, $[\text{NH}_3(\text{R}^5)_1]^+$, and $[\text{N}(\text{R}^5)_4]^+$, phosphoniums selected from the group consisting of $[\text{PH}(\text{R}^5)_3]^+$, $[\text{PH}_2(\text{R}^5)_2]^+$, $[\text{PH}_3(\text{R}^5)_1]^+$, and $[\text{P}(\text{R}^5)_4]^+$, carboniums $[\text{C}(\text{R}^5)_3]^+$, $[\text{H}(\text{OEt}_2)_2]^+$, $[\text{Ag}]^+$, and $[\text{Cp}_2\text{Fe}]^+$, in which R^5 is a linear or branched C_{1-20} alkyl group; an alkyl or silylalkyl group substituted with a halogen; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a cycloalkyl or silyl cycloalkyl group substituted with a halogen; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; an aryl or silyl aryl group substituted with a halogen; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; or an aralkyl or silyl aralkyl group substituted with a halogen, wherein anion is an anion capable of weakly coordinating to the palladium of the precatalyst, and is a borate represented by Chemical Formula 4a or 4b;

Chemical Formula 4a



Chemical Formula 4b



wherein

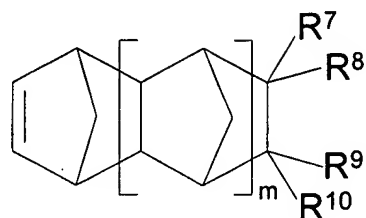
M' is a boron;

R^6 is a halogen; a linear or branched C_{1-20} alkyl or alkenyl group unsubstituted or substituted with a halogen atom; a C_{3-12} cycloalkyl group unsubstituted or substituted with a halogen; a C_{6-40} aryl group which unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group substituted with a linear or branched C_{3-20} trialkylsiloxy group or a linear or branched C_{18-48} triarylsiloxy group; or a C_{7-15} aralkyl group unsubstituted or substituted with a halogen, and

a and b are the number of the cations and anions, respectively, and determined to

allow the cation and anion to be electrically neutralized and balance the charges;

Chemical Formula 5



wherein

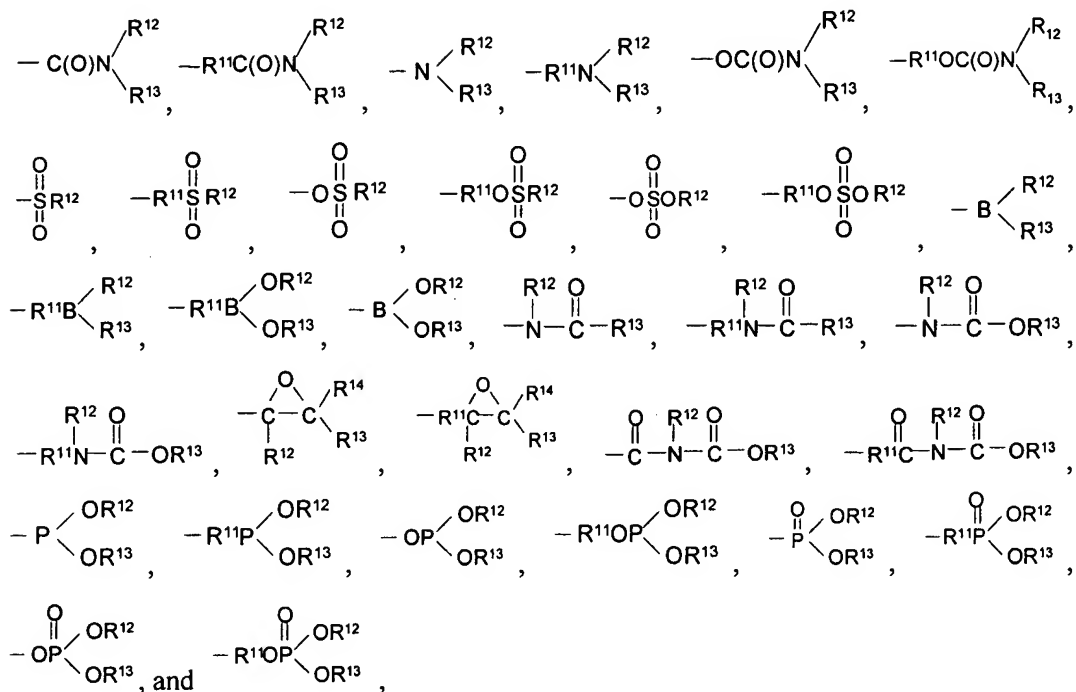
m is an integer of 0 to 4,

at least one of R^7 , R^8 , R^9 and R^{10} is a polar functional group, the others are non-polar functional group, and R^7 , R^8 , R^9 and R^{10} can be bonded together to form a saturated or unsaturated C_{1-20} cyclic group or C_{6-24} aromatic ring,

the non-polar functional group includes hydrogen; halogen; a linear or branched C_{1-20} alkyl group; a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl,

the polar functional group is a non-hydrocarbonaceous polar group containing at least one of O, N, P, S, Si and B, and is selected from the group consisting of: OR^{12} , $OC(O)OR^{12}$, $R^{11}OC(O)OR^{12}$, $C(O)R^{12}$, $R^{11}C(O)R^{12}$, $OC(O)R^{12}$, $R^{11}OC(O)R^{12}$, $(R^{11}O)pOR^{12}$, $(OR^{11})pOR^{12}$, $C(O)OC(O)R^{12}$, $R^{11}C(O)OC(O)R^{12}$, SR^{12} , $R^{11}SR^{12}$, SSR^{12} , $R^{11}SSR^{12}$, $S(=O)R^{12}$, $R^{11}S(=O)R^{12}$, $R^{11}C(=S)R^{12}$, $R^{11}C(=S)SR^{12}$, $R^{11}SO_3R^{12}$, SO_3R^{12} , $R^{11}N=C=S$,

NCO, $R^{11}NCO$, CN, $R^{11}CN$, $NNC(=S)R^{12}$, $R^{11}NNC(=S)R^{12}$, NO_2 , $R^{11}NO_2$,



in which R^{11} is a linear or branched C_{1-20} alkyl group; a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl,

R^{12} , R^{13} , and R^{14} are each independently hydrogen; a halogen; a linear or branched C_{1-20} alkyl group; a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} haloalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted

or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₆₋₄₀ aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C₇₋₁₅ aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; or alkoxy, haloalkoxy, carbonyloxy, halocarbonyloxy, and

p is an integer of 1 to 10.

33. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 32, wherein the molar ratio of the catalyst mixture based on the precatalyst to the monomer contained in the monomer solution is in the range of 1:5,000 - 1:20,000.

34. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 32, wherein the polar functional group of the norbornene-based compound is an ester group or an acetyl group.